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(54) Title: **NETWORK-BASED PHOTOMASK DATA ENTRY INTERFACE AND INSTRUCTION GENERATOR FOR MANUFACTURING PHOTOMASKS**

(57) Abstract: A computer network for generating instructions for photomask manufacturing equipment, based on photomask specification data input by a customer. A series of order entry screens are downloaded to a remote customer's computer, typically via an internet connection. The customer is prompted to enter photomask specification data, which is delivered to computing equipment on the manufacturer's local network. The manufacturer's computing equipment validates the photomask specification data, and uses this data to generate fracturing instructions and equipment control instructions. The fracturing instructions, together with pattern design data from the customer, are delivered to a fracture engine, which provides fractured pattern data. The control instructions and the fractured pattern data may then be electronically delivered to the manufacturing equipment.

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NETWORK-BASED PHOTOMASK DATA ENTRY INTERFACE AND
INSTRUCTION GENERATOR FOR MANUFACTURING PHOTOMASKS

TECHNICAL FIELD OF THE INVENTION

This invention relates to the manufacture of photomasks, and more particularly to a network-based system that permits a remote customer to provide pattern
5 design data and photomask specifications, and that uses this data to generate instructions for photomask manufacturing equipment.

BACKGROUND OF THE INVENTION

10 Photomasks are an integral part of the lithographic process of semiconductor manufacturing. Photomasks are quartz or glass plates that contain precision images of layers of integrated circuits. They are used to optically transfer the images to semiconductor wafers
15 during photoresist exposure.

Photomasks require complex mathematical algorithms for their design and use sophisticated manufacturing techniques. To make a photomask, a customer, such as a chipmaker, provides the photomask manufacturer with
20 circuit design data and photomask specifications. This data is used to generate photomask pattern data in a format appropriate for the manufacturing equipment. Each photomask is then created by using photolithographic techniques.

25 Conventionally, the data provided by the customer is in whatever format is convenient for the customer, based on the customer's design system. The circuit design data is typically from a CAD type system, with a design for each pattern. The data might be delivered to the
30 manufacturer on various media, such as a floppy disk,

magnetic tape, cassette, or via a modem connection. The photomask specifications might be in hardcopy form or in electronic form, on some sort of physical media delivered to the manufacturer, or delivered electronically. There
5 is no guarantee that this customer-provided data will be complete or that it will result in a manufacturable photomask.

SUMMARY OF THE INVENTION

10 One aspect of the invention is a network-based method of generating instructions for use by photomask manufacturing equipment. A customer computer establishes a remote connection to wide area network, also accessible by a local network of the manufacturer. A series of
15 order entry display screens is downloaded to the customer computer. These screens prompt the customer to enter photomask specification data, which identifies layers, patterns, placements, and fracturing data for at least one photomask. This photomask specification data is
20 communicated to a local network of the photomask manufacturer. The local network validates the photomask specification data during the remote connection. The local network also generates two types of instructions in response to the photomask specification data: fracturing
25 instructions and equipment control instructions. The fracturing instructions operate on pattern design data from the customer so as to provide fractured pattern data. Both the fractured pattern data and the control instructions may be electronically delivered to the
30 manufacturing equipment.

An advantage of the invention is that the local network operates directly in response to customer-provided photomask specification data. It does not

require data input by the photomask manufacturer. The method occurs "on-line", in the sense that photomask specification data is received and processed using electronic transfers of the data. It is received in a desired format, so that no reformatting is required for the input to the command generator.

This method of entering photomask specification data greatly reduces the time required to manufacture a photomask. For example, when patterns are manually fractured in the conventional manner, the fracturing process can take up to 70 times longer than with the present invention. With the present invention, fracturing instructions may be generated as the customer is entering order data.

At the same time, the invention ensures that the customer provides all necessary information, for both manufacturing and accounting. Information is received in a uniform format. The order data is verified to ensure that the photomask is manufacturable. The order entry process may be easily integrated with a billing system for accounting purposes.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1A illustrates a network-based system for obtaining photomask data and generating manufacturing instructions in accordance with the invention.

FIGURE 1B illustrates the method followed by the system of FIGURE 1A.

FIGURE 1C illustrates the order entry steps of FIGURE 1B.

FIGURES 2 - 7 illustrate various display screens downloaded to the customer's computer, consistent with the order entry steps of FIGURE 1C.

FIGURE 8 illustrates a display screen for entering billing information during the billing data step of FIGURE 1B.

FIGURE 9 illustrates a validation screen for
5 displaying the results of the validation step of FIGURE 1B.

FIGURES 10A and 10B illustrate an order summary display, which is delivered to the manufacturing plant.

10 DETAILED DESCRIPTION OF THE INVENTION

System Overview

FIGURE 1A illustrates a network-based system for obtaining photomask data and generating manufacturing instructions in accordance with the invention. FIGURE 1B
15 illustrates the method performed by the system of FIGURE 1A.

Computers 102, 108, 114, and 118 are assumed to have the processing resources and memory to implement the functions described herein. They are further assumed to
20 have associated program memory for storing programming for those functions.

As indicated in FIGURE 1A, the customer is assumed to have a customer computer 102, as well as a circuit design computer 104 and circuit design database 106. The
25 customer's computing equipment could be on a local network of the customer.

The rest of the computing equipment shown in FIGURE 1A are elements of a local network 100 operated by the photomask manufacturer. In the example of FIGURE 1A, all
30 of this equipment is on the same local area network (LAN), but other processing architectures are possible.

With regard to distribution of processing tasks on the computer equipment, FIGURES 1A and 1B are but one

possible embodiment. For example, various processing tasks performed by computers 108, 114, and 118 on the manufacturer's local network 100 could be performed on fewer computers. As another example, although FIGURE 1B illustrates Steps 120 - 124 as being all performed by a single interface computer 108, these steps could be performed on different computer equipment. Although the following description refers to certain processing tasks as being performed by specific computers in local network 100, in a more general sense, these tasks can be thought of as being performed by local network 100.

Customer computer 102 provides access, via a remote connection, to an interface computer 108. The network access may be via any LAN or WAN. Typically, the remote connection is via a wide area network (WAN). For example, the network could be the Internet, and customer computer 102 could establish a connection to a web site. Various user interface screens described herein are downloaded to customer computer 102. Interface computer 108 would receive the photomask data that the customer enters on these screens. The various network servers and other equipment will vary depending on the type of network; only the end stations are illustrated in FIGURE 1A. In the case of an Internet connection, customer computer 102 need not have special programming other than a web browser.

The customer also has a circuit design computer 104. Circuit design computer 104 stores programming for generating designs the customer's integrated circuit. It is possible that computers 102 and 104 could be the same equipment, although typically, computer 102 is a PC type computer and computer 104 is a UNIX type workstation. The customer's circuit design data is stored in the

customer's design library database 106. As illustrated by Step 127 of FIGURE 1B, at some point prior to manufacture of the photomask(s), this design data is transferred to customer design database 110 for access by
5 the manufacturer's local network.

Interface computer 108 stores programming for receiving photomask specification data from the customer via the network connection. In other words, photomask specification data is received on-line from the customer,
10 using order entry forms that organize the data in a particular format. This data is immediately available to other computing equipment on the manufacturer's local network. Interface computer 108 also stores programming that uses the photomask specification data to design one
15 or more photomasks that will meet all manufacturing requirements as well as the customer's specifications. Steps 120 - 124 of FIGURE 1B illustrate an order entry process and other processes performed by interface computer 108.

20 Computer 108 stores the photomask specification data in photomask specification database 112. This data is accessed by command generator 114, which generates instructions that are delivered to the photomask fabrication equipment. Specifically, command generator
25 114 generates fracturing instructions which are delivered to fracture engine 116. Fracture engine 116 also receives pattern design data from database 110 and generates fractured pattern data. The command generator 114 also generates control instructions, which specify
30 where and how patterns are to be written.

The fractured pattern data and the control instructions are delivered to memory accessible by the manufacturing equipment, which produces a photomask for

each layer of the integrated circuit. In today's manufacturing environment, the manufacturing equipment is computer-controlled lithography equipment.

Billing file generator 118 is used to interface the
5 photomask specification data to the manufacturer's billing system. It selects appropriate data and arranges it in a format useable by the billing system.

On-Line Entry of Photomask Specifications

10 FIGURE 1C illustrates a number of steps performed during Step 121 of FIGURE 1B. During this step, interface computer 108 receives photomask specification data, using a forms type order entry interface. As explained below, it is assumed that the customer has
15 accessed a network for downloading various user interface screens. These screens are displayed on customer computer 102, and guide the customer to enter photomask specification data.

Each of the Steps 131 - 136 of FIGURE 1C is
20 associated with a different user interface screen. These screens are illustrated in FIGURES 2 -7. To submit a photomask order, the customer accesses these screens in succession and enters data as prompted by each screen.

The display screens are arranged in a manner that
25 delivers data to interface computer 108 in a form that permits computer 108 to generate appropriate instructions for that order. The screens have various interface features known to persons who use windows-type operating systems. These features include data entry boxes, pull
30 down menus, and selection buttons and bars. Help icons permit the customer to view help information.

FIGURE 2 illustrates a log-in screen 20, which is the first screen that the customer views. Where access

is via the Internet, this screen is displayed in response to the customer entering the URL of the photomask manufacturer.

Each order requires that the customer first have an
5 account. A new-customer link 21 permits the customer to set up an account and thereby receive a username and password. At this time, the customer may also be set up for network access to customer design database 110. This permits the customer to electronically transfer circuit
10 design data from the customer's database 106 to a database 110 maintained by the manufacturer. As explained below, this transfer need not be accomplished by the same network connection as is used to create an order.

15 To enter an order, the user is prompted to enter a username and password. A menu 22 permits the user to request that a new order be created.

FIGURES 3A and 3B illustrate a general tooling data screen 30. A navigation bar 30a at the top of screen 30
20 informs the customer of the current location within the design process and permits the customer to navigate among all screens.

An order copy box 31 permits the customer to reload an order in progress or to create a new order based on an
25 old order. This reduces the need for the customer to re-enter data that is to be re-used for the new order.

A customer information box 32 prompts the customer to enter relevant contact information. A quality control box 33 provides a pull down menu for types of quality
30 control, such as die to die, manual, or die to database. A documentation box 34 provides a pull down menu for selecting documentation.

A layer and pattern box 35 prompts the user to name the device, and to specify the number of layers and patterns. A tooling and materials box 37 provides pull down menus for product type, glass type, glass size and thickness, and coating. A reflectivity specification may also be entered. A pellicle box 36 permits the customer to specifies pellicle data. Various stepper data may also be entered.

A "create and forward" button 38 prompts the customer to save the information entered on screen 30 and proceed to the next screen. The information entered on screen 30 is carried forward to subsequent screens.

FIGURE 4 illustrates a layer data screen 40, which prompts the customer to enter data for each layer. Screen 40 has a layer data line 41 for only one layer. Additional lines 41 would be displayed for additional layers, such that there are as many lines 41 as there are layers specified in box 35 of screen 30. For each layer, the customer is prompted to enter a title, a barcode, a registration tolerance, and other layer information.

FIGURE 5 illustrates a pattern data screen 50. A set of pattern data lines 51 is displayed for every pattern specified in screen 30. On a first line of set 51, the customer enters a pattern name, which identifies the pattern as a primary, test, frame, or other type of pattern. The customer also specifies whether the pattern is to be fractured. On subsequent lines of set 51, for each layer, the customer specifies a number of placements, the location of the placements, and other fracturing data. Critical dimension (CD) data permits the manufacturer to verify whether the photomask meets the customer's specifications. Although there is only a single layer in the example of FIGURE 5 (and thus two

lines in set 51), additional lines would be generated for additional layers.

FIGURE 6 illustrates a pattern placement screen 60. Using screen 60, the customer specifies where to place each pattern. As indicated in line 61, pattern data is
5 carried forward from screen 50, so that screen 60 progresses through each layer and each pattern on each layer.

FIGURE 7 illustrates a pattern fracture screen 70.
10 Again, data from prior screens is carried forward. Although FIGURE 7 illustrates data entry for a single pattern, line 71 would be repeated for each pattern, as are the data entry boxes. A database entry line 72 prompts the customer to enter data used to identify and
15 locate pattern data in the customer database 110. Additional boxes 73 on screen 70 prompt the customer to enter scale, GDS, and window limit data.

Processing Additional to Order Entry

20 Referring again to FIGURE 1A and 1B, various steps additional to customer order entry (Step 121) are illustrated. As explained below, these steps occur simultaneously with, or subsequent to, order entry.

Step 125 occurs after Step 121. The data entered by
25 the customer during the order entry process is stored as photomask specification data in photomask specification database 112.

Step 122 is receiving billing data from the customer. This step may occur during the same network
30 connection as Step 121. In the example of this description, a billing data screen immediately follows screen 70.

FIGURE 8 illustrates a billing data screen 80, used to receive billing data for Step 122. The customer is prompted to enter various information for use in billing for the photomask(s).

5 Step 123 is a validation step, which may be performed during or after Step 121. That is, Step 123 may be performed while the customer is still on-line. In Step 123, interface computer 108 processes the order data to ensure that it is valid. Examples of validation
10 techniques include ensuring that the customer has entered all required data during Step 120. As another example, customer data might be checked to ensure that specified patterns will fit on the layer. A detailed description of the validation is set out below.

15 FIGURE 9 illustrates a validation screen 90. Screen 90 indicates that Step 123 has been performed. If one of the validation tests of Step 123 had failed, the customer would be informed with a different message in screen 90 and given an opportunity to return to the screen whose
20 data caused the lack of validity, so the error could be corrected.

FIGURES 10A and 10B illustrate an order summary screen 100, which is delivered to the plant that is to produce the photomask(s). An order summary may also be
25 sent to the customer computer 102. Screen 100 may be delivered electronically or printed and delivered in hardcopy form.

In Step 124, certain items of the order entry data are selected and arranged for use by a billing system.
30 For example, the order data may be formatted as a "semi file", which complies with a semiconductor industry standard for order information. A special billing data generator 118 may be used for this task. However, as

stated above in connection with FIGURES 1A and 1B, the division of processing tasks performed by the computing equipment of local network 100 may vary in different embodiments of the invention.

5 Step 126 is performed as the customer inputs data (during Step 121). During Step 126, command generator 114 receives the fracturing data entered into screen 70. It uses this data, as well as fracturing algorithms stored in its program memory, to generate fracturing
10 instructions.

For some manufacturing systems, the fracturing instructions for a particular set of patterns are referred to as a "cinc file". The following instructions represent a portion of cinc file, and describe a single
15 pattern.

```
!Fracture_1
clear
Allocate_rects 500000
20 Allocate_traps 500000
Allocate_space 20000000
Format MEBES
Mebes MACHINE 3
Compact FLY
25 Rule PARAGON
Border OUTSIDE
Input $INPUT_PATH/JEFF.GDS
Resolution 0
Structure MAIN
30 Layers 1,3,5,7
Limits (-12000, -15000, 12000, 15000)
Scale 1
Output $OUTPUT_PATH/dpi000000_22.cflt
Do
35
```

A complete cinc file would have a similar description for each pattern.

The automatic generation of fracturing instructions eliminates the errors associated with manual input. The

fracturing instructions may be generated "on-line" as the customer enters pattern and fracture data. As stated above in connection with FIGURES 1A and 1B, the fracturing instructions are used in conjunction with the customer's design data to create photomask patterns recognizable by the manufacturing equipment.

In Step 127, command generator 114 receives the photomask specification data from database 112. It uses this data to generate instructions for the manufacturing equipment. The result is a set of computer instructions that will cause the patterns to be written on the photomask plate. These instructions are sometimes referred to as a "job deck".

In Step 128, the customer's circuit design data is delivered to the manufacturer. If the design data is sent in electronic form, it may be sent over a connection different from that of the network used for order entry. For example, a secure FTP file transfer could be used. The design data is stored in a customer database 110.

Validation of Photomask Specification and Billing Data

As stated above, in Step 123, the customer's photomask specification data may be validated on-line, i.e., as it is being entered.

The following validation process is one example of a set of tasks performed during Step 123. As indicated below, many of the validation tasks can be categorized. Some tasks determine whether specified data has been entered. Other tasks determine whether data is in a specified format, i.e., decimal in range. Other tasks determine whether data meets specified dimensional

criteria, such as whether patterns fit on a mask or whether placements line up.

For each of the screens illustrated in FIGURES 3A - 9, the following validation tasks occur:

5

General tooling data screen 30:

Validated to exist:

Customer Name

Device Name

10

Number of layers

Number of patterns

Validated be integer in range

Number of layers (1-99)

Number of patterns (1-99)

15

Validated to be decimal in range

Reflectivity (0.0 - 100)

Special validation

Email address

20

Layer Data Screen 40:

Validated to exist

Layer name

Special validation

Layer names are validated to be unique

25

Pattern Data Screen 50:

Validated to exist

Number of pattern placements per layer

Validated to be integer in range

30

Number of pattern placements per layer (0-99)

Validated to be decimal in range

Address units out (0.0 - 10.0)

Final CD Size (any decimal)

35

CD Tolerance (0.0 - 1000.0)

Pattern Placement Screen 60:

Validated to be decimal

Placement X (any decimal)

40

Placement Y (any decimal)

Pattern Fracture Screen 70:

Validated to be decimal in range

Fracture data scale out (0.0 -10000.0)

45

Special Validation

Fracture database name is validated to be
valid file name

Fracture top structure is validated to be
valid file name

5 Window limits are validated so that the
absolute value of upper right X - lower
left X is less than or equal to the width
of the glass

10 Window limits are validated so that the
absolute value of upper right Y - lower
left Y is less than or equal to the height
of the glass

Billing Data Screen 80:

15 Special Validation

Account manager email, billing information
email, and shipping information email are
all validated to make sure they could be
valid email addresses

20

Validation Screen 90:

Customer name

Device

Contact name

25 Contact phone

Contact fax

Contact email

Product type

Glass Type

30 Glass Size/Thickness

Glass Coating

Defect Criteria

Plot Size

Number of layers

35 Number of patterns

Validate Fields For Screen: Order Business
Info

PO Number

40 Billing Address

Billing City

Billing State

Billing Country

Billing Zip

45 Bill Contact

Bill Contact Phone

Bill Contact Fax

Bill Contact Email

Shipping Address

Shipping City
Shipping State
Shipping Country
Shipping Zip
5 Ship Contact
Ship Contact Phone
Ship Contact Fax
Ship Contact Email

10 Get the number of layers
Walk through layers & validate each one:
Get the array of layer attributes
Validate Fields For Screen: Layer Info
Mask Title
15 Barcode text (if required based on
previous information)
Mask Parity
Title Parity
Next Layer

20 Validate pattern data
Pattern Name
Fracture Required
Decide whether fracture required or not
Validate Fields For Screen: Fracture Info
25 NOTE: these are only the top level
fields, not layer dependent
Database Name
Top Structure
Data Scale Out
30 Window Limits - LLX
Window Limits - LLY
Window Limits - URX
Window Limits - URY

35 Get & validate pattern arrays
Initialize the total placements
Validate pattern array data (Pattern &
Fracture)
Validate the pattern info
Address Units Out
40 Final CD Size
CD Digitized
Digitized Data Tone
Validate the fracture info
GDS Layers
45 Input pattern file name
Get & validate number of placements
Validate placement data
Get the placement attributes
Form the root for the error message

Validate Fields For Screen: Placement Info
X Value
Y Value
Next Placement
5 End If numPatternLayerPlacements > 0
Next Pattern layer
Next Pattern

Other Embodiments

10 Although the present invention has been described in detail, it should be understood that various changes, substitutions, and alterations can be made hereto without departing from the spirit and scope of the invention as defined by the appended claims.

WHAT IS CLAIMED IS:

1. A computer network for generating instructions for use by photomask manufacturing equipment, comprising:

an interface computer accessible to a remote customer computer via a remote network connection, and during the network connection, the interface computer operable to perform the following tasks: receive photomask specification data from the customer computer, validate the photomask specification data, and download validation results to the customer computer;

wherein the photomask specification data at least identifies layers, patterns, placements, and fracturing data for at least one photomask;

a photomask specification database in communication with the interface computer, operable to store the photomask specification data;

a command generator in communication with the photomask specification database, operable to generate fracturing instructions and control instructions in response to the photomask specification data;

a customer design database that stores design data for the photomask; and

a fracture engine that receives the fracturing instructions and the design data and uses this data to generate fractured pattern data.

2. The network of Claim 1, wherein the remote network connection is an internet connection.

3. The network of Claim 1, wherein the customer design database has a communications interface for receiving design data from the customer in electronic form.

4. The method of Claim 3, wherein the design data is received during the same network connection as the photomask specification data.

5. The network of Claim 1, further comprising a billing data generator that selects billing data from the photomask specification data and arranges the billing data in a format suitable for a billing system.

6. The network of Claim 5, wherein the billing data generator arranges the billing data as a semi file.

7. The network of Claim 1, wherein the command generator is further operable to deliver the control instructions to memory accessible by the manufacturing equipment.

8. The network of Claim 1, wherein the fracture engine is further operable to deliver the fractured pattern data to memory accessible by the manufacturing equipment.

9. The network of Claim 1, wherein the fracturing instructions are in the form of a cinc file.

10. The network of Claim 1, wherein the interface computer validates the photomask specification data by

determining whether data has been entered in a specified format.

11. The network of Claim 1, wherein the interface computer validates the photomask specification data by determining whether data complies with dimensional criteria.

12. The network of Claim 1, wherein the interface computer validates the photomask specification data by validating fracturing data.

13. A network-based method of generating instructions for use by photomask manufacturing equipment, comprising the steps of:

downloading a series of display screens to a customer computer via a remote network connection, each of the network screens operable to prompt the customer to enter photomask specification data;

wherein the photomask specification data at least identifies layers, patterns, placements, and fracturing data for at least one photomask;

receiving the photomask specification data from the customer computer via the remote network connection, at local computing equipment on a local network of the photomask manufacturer; and

using the local computing equipment to perform the following tasks: to validate the photomask specification data during the remote network connection; to generate fracturing instructions in response to the photomask specification data; to receive pattern design data from the customer; to use the fracturing instructions and the pattern design data to generate fractured pattern data; and to generate control instructions for the manufacturing equipment.

14. The method of Claim 13, wherein the remote network connection is an internet connection.

15. The method of Claim 13, wherein the local computing equipment receives the pattern design data from the customer in electronic form.

16. The method of Claim 15, wherein the design data is received during the same network connection as the photomask specification data.

17. The method of Claim 13, wherein the downloading step is further performed by downloading a screen operable to prompt the use to enter billing data, and further comprising the steps of arranging the billing data in a format suitable for a billing system, and delivering the billing data to the billing system.

18. The method of Claim 13, wherein the screens comprise at least a layer data screen and a pattern data screen and wherein the pattern data screen lists layers based on data provided to the layer data screen.

19. The method of Claim 13, wherein the screens comprise at least a layer data screen and a pattern placement screen and wherein the pattern placement screen lists layers based on data provided to the layer data screen.

20. The method of Claim 13, wherein the screens comprise at least a pattern data screen and a fracture screen, and wherein the fracture screen lists patterns based on data provided to the pattern data screen.

21. The method of Claim 13, wherein the local computing equipment further delivers the fractured pattern data and the control instructions to the manufacturing equipment.

22. The method of Claim 13, wherein the local computing equipment comprises an interface computer, a command generator, and a fracture engine, implemented on at least one computer.

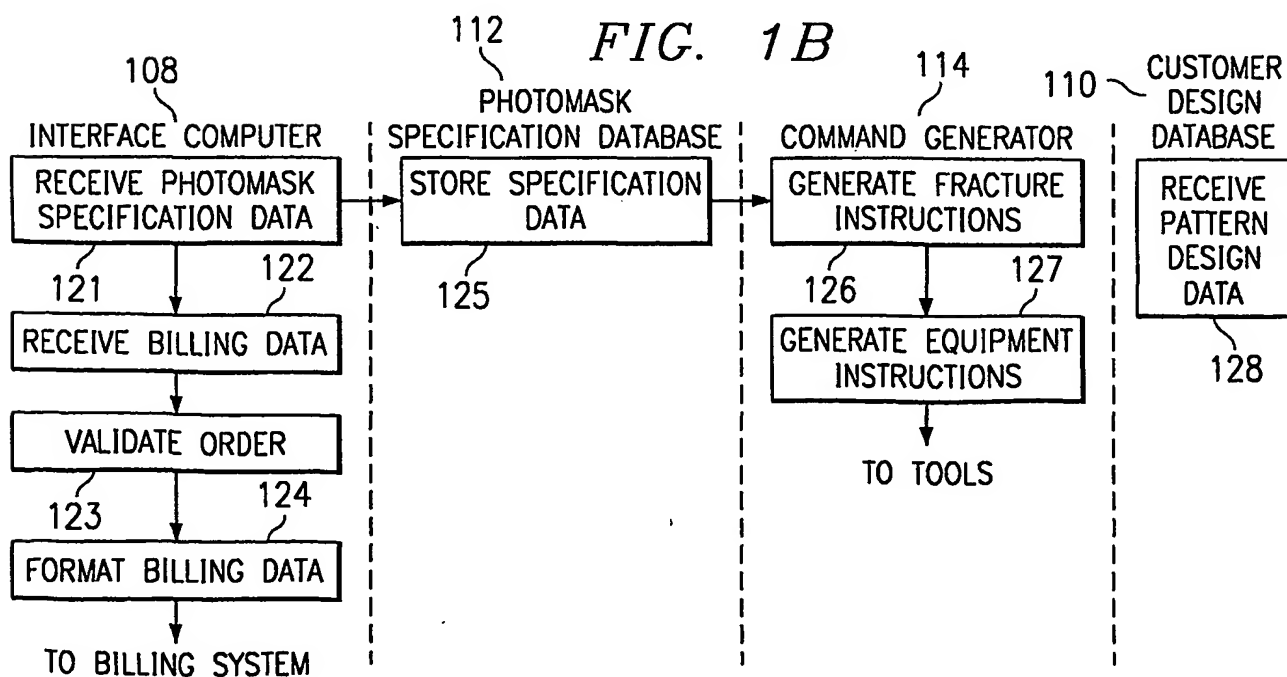
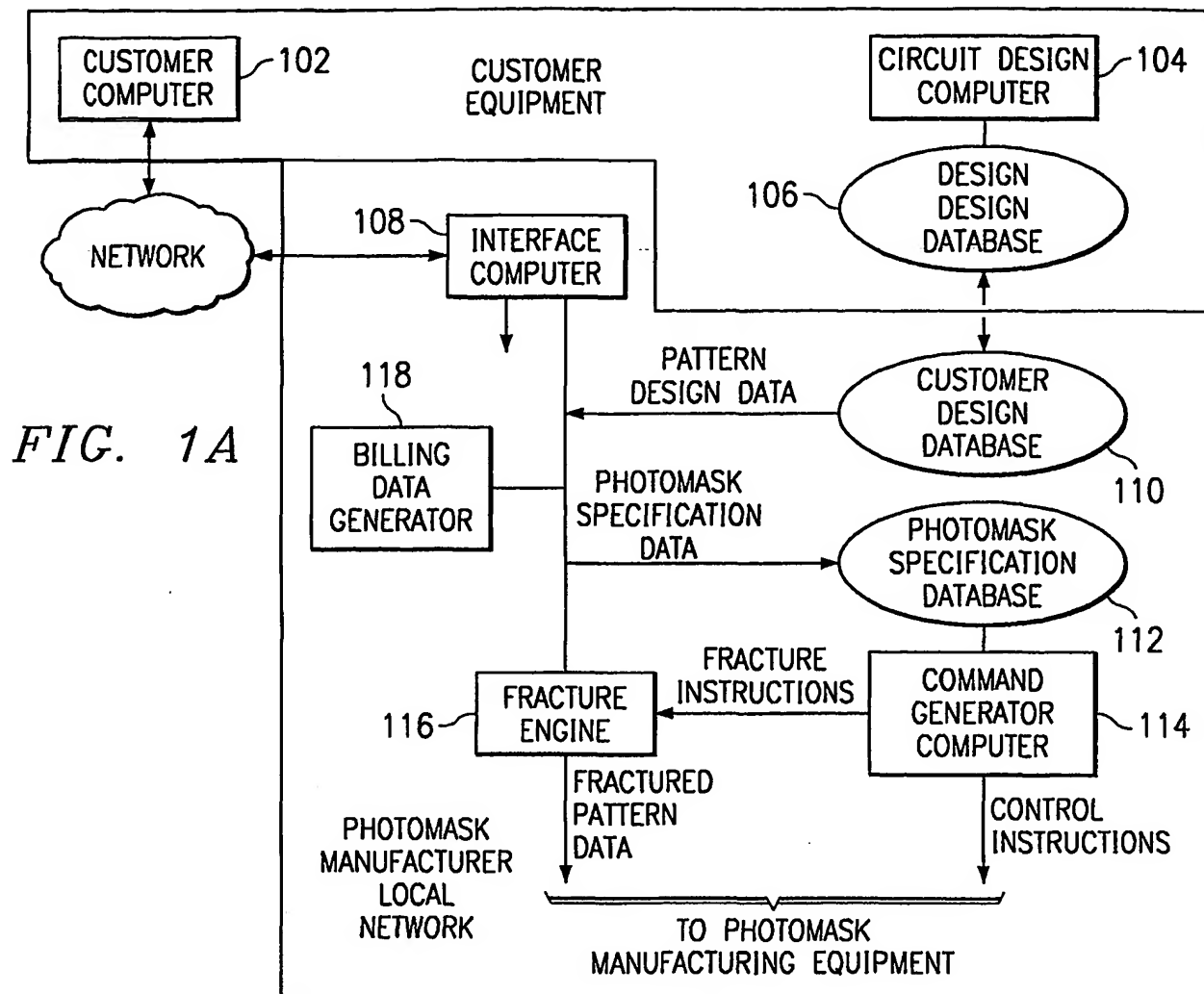
23. The method of Claim 13, wherein the local computing equipment further generates a billing file for use by the manufacturer's billing system.

24. The method of Claim 13, wherein the local computing equipment validates the photomask specification data by determining whether data has been entered in a specified format.

25. The method of Claim 13, wherein the local computing equipment validates the photomask specification data by determining whether data complies with dimensional criteria.

26. The method of Claim 13, wherein the local computing equipment validates the photomask specification data by validating fracturing data.

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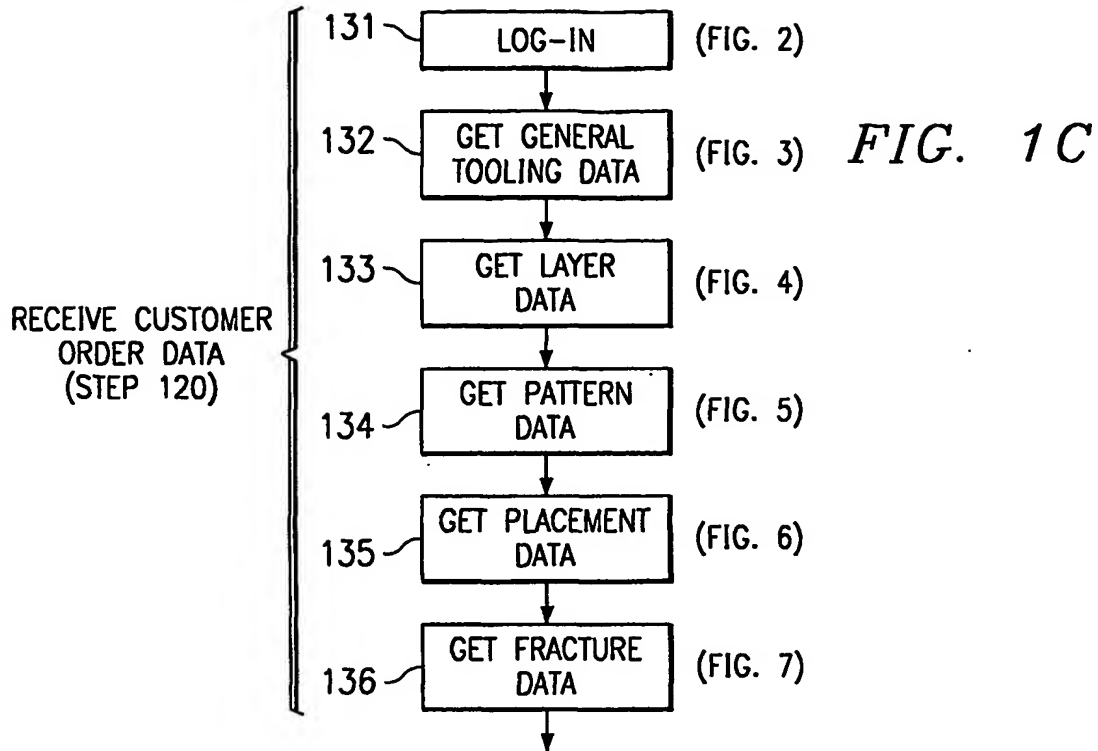


FIG. 2

20
?

Main Menu	Get a Quote/Account	Account	Mask Order	Info	Feedback
				Help	Logout

Please choose from the menu of choices below.

New Customers	Existing Customers
<p><u>Get a Quote/Account</u></p> <p>21 Choose this link if you are a new customer and do not have an account and password yet. It allows you to request a new quote, and/or request an Order Form account.</p>	<p>Enter your user name and password, choose a task, and click the "Go" button.</p> <p>User Name: <input type="text"/></p> <p>Password: <input type="password"/></p> <p>I want to: <input type="button" value="Create a New Order"/> 22</p> <p><input type="button" value="Go!"/></p>

All transactions are protected with SSL, the strongest browser encryption technology available on the web.

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30a {

Main Menu	Get a Quote/Account	Account	Mask Order	Info	Feedback		
Instructions	General	Layers	Patterns	Placements	Fractures	Business	Submit

Please create your new order by completing as thoroughly as possible the following fields, then pressing the "Save and Forward" button to progress to *Layer Information*, the next step of the Mask Order Wizard.

To get help for any field, hold your mouse cursor over that field's help icon (?).

30 {

Other Methods For Working With Orders	
Reload an In-progress Order:	<input type="text"/> <input type="button" value="Reload"/>
Create New Order Based On Old:	<input type="text"/> <input type="button" value="Copy to create new order"/>

31 {

← Create And Back Create And Stay

Create And Forward →

33 {

Customer Information	Quality Control
Customer: <input type="text"/> !	Defect Criteria: <input type="text"/> !
Fab: <input type="text"/> ?	
Contact Name: <input type="text"/> !	Documentation
Phone: <input type="text"/> !	
Fax: <input type="text"/> !	
E-mail: <input type="text"/> !	Plot Size: <input type="text"/> !

32 {

34 {

TO FIG. 3B
FIG. 3A

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FIG. 3B

FROM FIG. 3A

Required Order Information

This information is required immediately in order to accurately generate the layer & pattern information screens.

35 { Device: !

Number of Layers: !

Number of Unique Device Patterns: !

Tooling and Materials

37 { Product Type: !

Other:

Glass Type: !

Glass Size & Thickness: !

Coating: !

Reflectivity: % ?

Pellicles

36 { Chrome-side? No ?

Glass-side? No ?

Stepper Manufacturer: ?

Other:

Stepper Model: ?

Chrome-side Part Number: ?

Glass-side Part Number: ?

Compacts

Compact Part Number: ?

30 { 38

? =Optional for order ! =Required for submit, optional for this screen ! =Required for this screen

Main Menu	Get a Quote/Account	Account	Mask Order	Info	Feedback
Instructions	General	Layers	Patterns	Help	Logout
Placements	Fractures	Business	Submit		

TestCompany
View summary
In Progress

Please complete the information for each layer, and press the "Save and Forward" button to progress to *Pattern Identification*.

If the number of layers that appear on this screen is wrong, please return to the Basic Info Screen and correct the number of layers, then return to this screen.

Layers 1 - 1 of 1

Layer	Mask Title	Barcode Text	Reg Tolerance	Defect Size	Defect Density	Mask Parity	Title Parity
1	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>	<div style="border: 1px solid black; height: 20px; width: 100%;"></div>

← Save And Back

Save And Forward →

Barcode Type:

Max Barcode Text Length:

Parity Examples:
 Right Reading: Right Reading
 Wrong Reading: gnibosЯ ɹnoɹW

← Save And Back

Save And Forward →

❓ = Optional for order
❗ = Required for submit, optional for this screen
❗ = Required for this screen

FIG. 4

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Main Menu	Get a Quote/Account	Account	Mask Order	Info	Feedback
				Help	Logout

Instructions	General	Layers	Patterns	Placements	Fractures	Business	Submit
--------------	---------	--------	----------	------------	-----------	----------	--------

TestCompany
[View summary](#)
In Progress

Please complete the information for each distinct pattern, and press the "Save and Forward" button to progress to *Pattern Placement*.

If the number of patterns or layer information is wrong, please return to the General Info Screen and correct the number of distinct patterns, then return to this screen.

← Save And Back
Save And Stay

Save And Forward →

Patterns 1 – 1 of 1
Layers 1 – 1 of 1

Pattern #	Pattern Name:	Fracture Required?
1	<input type="text"/> ▼	<input type="checkbox"/> ▼

Layer	Number of Placements	Address Units Out (μ)	Final CD Size(μ)	CD Tolerance (μ)	CD Digitized?	Digitized Data Tone
1 <i>Patent application</i>	<input type="text"/>	<input type="text"/>	<input type="text"/>	+/- <input type="text"/>	<input type="text"/> ▼	<input type="text"/> ▼

← Save And Back
Save And Stay

Save And Forward →

⓪ =Optional for order
Ⓢ =Required for submit, optional for this screen
Ⓡ =Required for this screen

FIG. 5

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Main Menu	Get a Quote/Account	Account	Mask Order	Info	Feedback
				Help	Logout
Instructions	General	Layers	Patterns	Placements	Fractures
				Business	Submit

TestCompany
[View summary](#)
In Progress

Please fill in the X and Y coordinates (in microns from the center of the mask, where the center is defined as 0,0) for every placement in each layer, and press the "Save and Forward" button to progress to *Fracture Information*.

If the number of placements for any layer on this screen is wrong, please return to the Layer Info Screen and change the number of placements, then return to this screen.

← Save And Back
Save And Stay

Save And Forward →

Layers 1 - 1 of 1

Layer Pattern
Placements (Array to-- → columns)

1 Patent Application

Prime-1

Placement 1

Xμ

Yμ

← Save And Back
Save And Stay

Save And Forward →

Field Help

X & Y		X-values and Y-values are in microns from the center of the mask (where the center is defined as 0,0) and thus can be positive or negative. X- and Y-values for all placements must be completed before the order can be submitted, but can be left blank for the time being if necessary.
-------	--	--

Ⓟ =Optional for order
 =Required for submit, optional for this screen
 =Required for this screen

FIG. 6

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Main Menu

Get a Quote/Account

Account

Mask Order

Info

Feedback

Help

Logout

Instructions

General

Layers

Patterns

Placements

Fractures

Business

Submit

TestCompany

View summary

In Progress

Please complete the fracture information for every fracture pattern, and press the "Save and Forward" button to progress to *Chip Placement*.

For patterns that are not fractures, you will have to provide a pattern file in either MEBES or CFLT format.

If the number of patterns that are fractures on this screen is wrong, please return to the Pattern Specification Screen and change the Fracture Required values, then return to this screen.

← Save And Back

Save And Stay

Patterns 1 - 1 of 1

Save And Forward →

71

Pattern	Fracture?	Database Name	Top Structure	Data Scale Out
1 Prime-1	Yes	<input type="text"/>	<input type="text"/>	<input type="text"/>

GDS Layers !

Layer 1

Patent Application

GDS Layers

Window Limits !

(μ)

Lower Left

X Y

Upper Right

X Y

← Save And Back

Save And Stay

Save And Forward →

? =Optional for order
! =Required for submit, optional for this screen
! =Required for this screen

FIG. 7

FIG. 8 9/12

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Main Menu		Get a Quote/Account		Account		Mask Order		Info		Feedback	
Instructions		General		Layers		Patterns		Placements		Fractures	
Business		Submit		Help		Logout					
TestCompany						View summary			In Progress		
<p>Please complete the business information for your order, and press the "Save and Forward" button to progress to <i>Submit Order</i>.</p>											
← Save And Back				Save And Stay				Save And Forward →			
Billing Information						Shipping Information (same as billing)					
PO Number: <input type="text"/> !						Street Address: <input type="text"/> !					
Street Address: <input type="text"/> !						<input type="text"/> ?					
<input type="text"/> ?											
City: <input type="text"/> !						City: <input type="text"/> !					
State: <input type="text"/> !						State: <input type="text"/> !					
Country: <input type="text"/> !						Country: <input type="text"/> !					
Postal Code: <input type="text"/> !						Postal Code: <input type="text"/> !					
Contact Name: <input type="text"/> !						Contact Name: <input type="text"/> !					
Phone: <input type="text"/> !						Phone: <input type="text"/> !					
Fax: <input type="text"/> !						Fax: <input type="text"/> !					
Email: <input type="text"/> !						E-mail: <input type="text"/> !					
Other Order Information											
Expected Delivery: <input type="text"/>						▼ ?			▲		
Comments/Instructions: <input type="text"/>						▼ ?			▲		
← Save And Back				Save And Stay				Save And Forward →			
<p>? =Optional for order ! =Required for submit, optional for this screen ! =Required for this screen</p>											

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FIG. 9

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Main Menu	Get a Quote/Account	Account	Mask Order	Info	Feedback		
				Help	Logout		
Instructions	General	Layers	Patterns	Placements	Fractures	Business	Submit

TestCompany RR	View summary	Validated
----------------	------------------------------	-----------

Congratulations!
Your order has been validated to contain all necessary information.

Submit the order
Click the button at the bottom of the screen to transmit the order information. You may then FTP the data files for the order.

You must click the button to submit the order. Once you click the button, you will not be able to change any of the order information using the Order Form. Instead, you will have to talk to a customer service representative to change any order information.

→ **FINALIZE ORDER AND SUBMIT** ←

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FIG. 10A

General Order Information Sales order: Site: Customer: Contact:		Business Information Billing information:	
Fab: Device: Product Type: Glass Type: Glass Size: Coating: Defect Criteria: Plot Size: Pellicle Chrome? Pellicle Glass? Stepper: Compact Part: Delivery: Comments:		Shipping information:	
		Manufacturer-specific Information:	

#	Mask Name	Barcode Text	Registration Tolerance	Defect Size	Defect Density	Mask Parity	Title Parity
1	SYSTEM TEST 1	KDKDKDK	0.150 um	1.0 um	0 def/sq.in	Wrong Reading	Wrong Reading
2	SYSTEM TEST 2	HSKSHSH	0.250 um	0.75 um	1 def/sq.in	Right Reading	Right Reading

Layers

TO FIG. 10B

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FIG. 10B

FROM FIG. 10A

Distinct Patterns

#	Pattern Name	Address Units Out	Final CD Size	Final CD Tolerance	CD Digitized	Digitized Data Tone	Fracture Database Name	Top Structure	GDS Layers	Data Scale Out	Window Limits
1	Prime-1-1	0	1	0	Yes	Dark	JEFF.GDS	MAIN	1,3,5,7	1	(-12000, -15000) (12000, 15000)
2	Scribe-2-2	0	1	0	No	Clear	JEFF.GDS	TOP	2,4,6,8	1	(-10000, -9000) (10000, 9000)

Placement of Patterns on Layers

Layer #	Mask Title	Pattern	X	Y
1	SYSTEM TEST 1			
			14000	9000
		Scribe-2-2		
			16000	10000
2	SYSTEM TEST 2			
		Scribe-2-2		
			13256	14859

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Declarations under Rule 4.17:

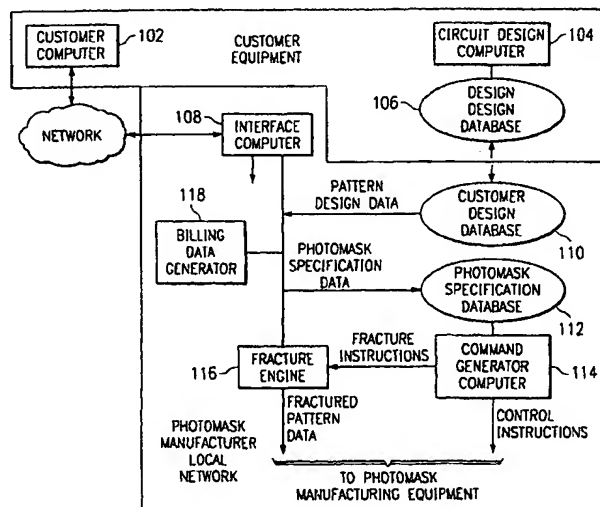
- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*

Published:

- *with international search report*

[Continued on next page]

(54) Title: **NETWORK-BASED PHOTOMASK DATA ENTRY INTERFACE AND INSTRUCTION GENERATOR FOR MANUFACTURING PHOTOMASKS**



(57) Abstract: A computer network for generating instructions for photomask manufacturing equipment, based on photomask specification data input by a customer. A series of order entry screens are downloaded to a remote customer's computer, typically via an internet connection. The customer is prompted to enter photomask specification data, which is delivered to computing equipment on the manufacturer's local network. The manufacturer's computing equipment validates the photomask specification data, and uses this data to generate fracturing instructions and equipment control instructions. The fracturing instructions, together with pattern design data from the customer, are delivered to a fracture engine, which provides fractured pattern data. The control instructions and the fractured pattern data may then be electronically delivered to the manufacturing equipment.

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— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

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INTERNATIONAL SEARCH REPORT

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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G06F G03F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

INSPEC, EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 933 350 A (FUJIMOTO SHINICHI ET AL) 3 August 1999 (1999-08-03) column 1, line 15 -column 2, line 24 column 2, line 63 - line 67 column 6, line 43 -column 7, line 32 --- -/--	1-26

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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- * & * document member of the same patent family

Date of the actual completion of the international search

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06/06/2002

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PCT/US 01/21020

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>PELTIER J ET AL: "Low cost, prototype ASIC and MCM fabrication and assembly from the MOSIS service"</p> <p>PROCEEDINGS. 1997 IEEE INTERNATIONAL CONFERENCE ON MICROELECTRONIC SYSTEMS EDUCATION, MSE'97. 'DOING MORE WITH LESS IN A RAPIDLY CHANGING ENVIRONMENT' (CAT. NO.97TB100127), PROCEEDINGS OF INTERNATIONAL CONFERENCE ON MICROELECTRONIC SYSTEMS EDUCATION,, pages 68-69, XP002199595</p> <p>1997, Los Alamitos, CA, USA, IEEE Comput. Soc. Press, USA</p> <p>ISBN: 0-8186-7996-4</p> <p>page 1 -page 2</p> <p>---</p>	1-26
X	<p>EP 1 003 087 A (D APPLIC COMP IND)</p> <p>24 May 2000 (2000-05-24)</p> <p>column 1, line 53 -column 3, line 5;</p> <p>figure 1</p> <p>column 3, line 19 -column 4, line 16</p> <p>column 5, line 20 -column 6, line 16</p> <p>---</p>	1-26
A	<p>US 5 950 201 A (MUELLER JOSEPH LAWRENCE ET AL) 7 September 1999 (1999-09-07)</p> <p>column 2, line 47 -column 3, line 57</p> <p>column 6, line 54 - line 67</p> <p>column 9, line 40 -column 13, line 22</p> <p>column 27, line 33 - line 51</p> <p>column 28, line 10 - line 39</p> <p>---</p>	1-26
A	<p>LUO R C ET AL: "Desktop rapid prototyping system with supervisory control and monitoring through Internet"</p> <p>IEEE/ASME TRANSACTIONS ON MECHATRONICS, DEC. 2001, IEEE, USA,</p> <p>vol. 6, no. 4, pages 399-409, XP002199596</p> <p>ISSN: 1083-4435</p> <p>page 399, left-hand column, paragraph 3</p> <p>-page 401, right-hand column, paragraph 1;</p> <p>figures 1-3</p> <p>page 403, left-hand column, paragraph 4</p> <p>-page 404, left-hand column, paragraph 1</p> <p>-----</p>	1-26

INTERNATIONAL SEARCH REPORT

Information on patent family members

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			EP	1003087 A1	24-05-2000
US 5950201	A	07-09-1999	NONE		

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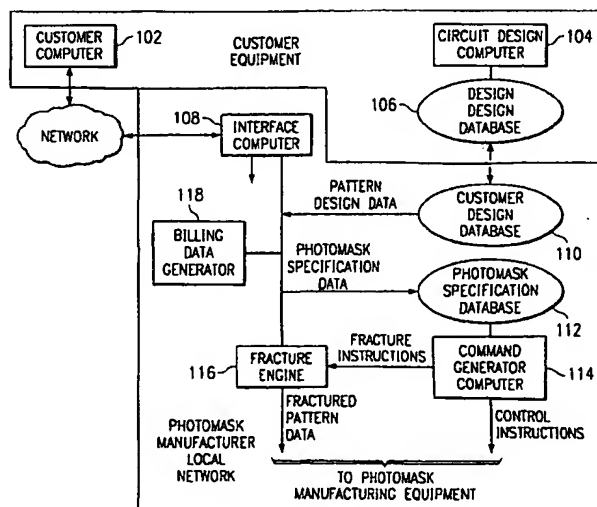
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131 Old Settlers Boulevard, Round Rock, TX 78664 (US).(72) Inventors: COGDELL, Thomas, T.; 2200 Canterbury
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Jacinto Blvd., Suite 1500, Austin, TX 78701 (US).(81) Designated States (*national*): AE, AG, AL, AM, AT (util-
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ity model), DE, DK (utility model), DK, DM, DZ, EC, EE
(utility model), EE, ES, FI (utility model), FI, GB, GD, GE,
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patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,
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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a
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- as to the applicant's entitlement to claim the priority of the
earlier application (Rule 4.17(iii)) for all designations

[Continued on next page]

(54) Title: NETWORK-BASED PHOTOMASK DATA ENTRY INTERFACE AND INSTRUCTION GENERATOR FOR MAN-
UFACTURING PHOTOMASKS

(57) Abstract: A computer network for generating instructions for photomask manufacturing equipment, based on photomask specification data input by a customer. A series of order entry screens are downloaded to a remote customer's computer, typically via an internet connection. The customer is prompted to enter photomask specification data, which is delivered to computing equipment on the manufacturer's local network. The manufacturer's computing equipment validates the photomask specification data, and uses this data to generate fracturing instructions and equipment control instructions. The fracturing instructions, together with pattern design data from the customer, are delivered to a fracture engine, which provides fractured pattern data. The control instructions and the fractured pattern data may then be electronically delivered to the manufacturing equipment.

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